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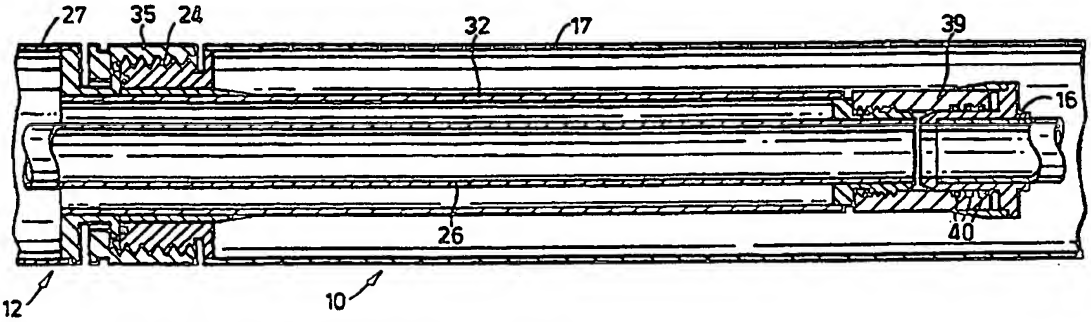

(57) Abstract

A quick release cryogenic coupling comprising first (10) and second (12) members each having inner (16, 26) and outer (17, 27) pipes, the inner pipe (26) extending beyond the outer pipe (27) in one member (12) and the outer pipe (17) extending beyond the inner pipe (16) in the other member (10). An intermediate pipe (32) is provided on at least one member which is either evacuable or permanently evacuated to provide thermal insulation over the inner pipes (16, 26). A nut (35) and bolt (24) is provided to releasably secure the outer pipe (17) of the first member (10) with the outer pipe (27) of the second member (12) in gas tight connection and a cryogenic seal (39) is carried on one inner pipe and is configured to receive the other inner pipe.

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QUICK RELEASE CRYOGENIC COUPLING

The present invention relates to quick release couplings for transfer systems used for cryogenic liquids such as liquid nitrogen.

Conventional quick release couplings, as commonly used with gas and hydraulic systems, rely on springs and diaphragms, which involve the use of metals and which in consequence do not function satisfactorily, if at all, at low temperatures due, in part, to a loss of resilience of the metal at these temperature.

Standard releasable couplings for cryogenic materials use metals such as brass, which do not become frangible at cryogenic temperatures, for male and female threaded components which are screwed together. Such couplings inevitably involve significant gasification of liquid at the initiation of flow therethrough. More significantly separation of the components is a lengthy process involving a period of time for the components to warm towards ambient temperatures after the end of cryogenic flow therethrough. Even after warming components of this type usually have to be hammered to loosen them before they can be unscrewed- a process which inevitably involves the risk of mechanical damage.

There is therefore a need for a quick release cryogenic coupling.

According to the present invention a quick release cryogenic coupling comprises first and second members each having inner and outer pipes, the inner pipe extending beyond the outer pipe in one member and the outer pipe extending beyond the inner pipe in the other member; an intermediate pipe provided on at least one member; connection means for releasably securing the outer pipe of the first member with the outer pipe of the second member in gas tight connection; and a cryogenic seal carried on one inner pipe; the configuration being such that, when the two members are connected together with the inner pipes connected by the cryogenic seal an evacuated space can be provided between the intermediate and inner pipes.

Conveniently the connection means may comprise a nut and bolt arrangement which, for speed of connection, may be provided with a coarse thread. This has the advantage that only a small number of turns of the nut will be required to effect the connection.

The intermediate pipe will usually be in the member where the inner pipe extends beyond the outer pipe, and the construction will be either such that the space between the intermediate and inner pipes contains a permanent vacuum or such that the space can be evacuated during operation of the connection.

The construction will preferably be such that, when the members are connected an evacuated space can be provided, either permanently or during operation, between the cryogenic seal and the outer pipe.

The the inner circumference of the cryogenic seal is preferably provided with at least one annular groove. This has the advantage that in use the cryogenic liquid can bleed into the annular space thus created to form a pressure tight, liquid seal.

In one form of quick release cryogenic coupling according to the invention the first member and second member is each attachable to either a delivery system or to a supply system;

the first member having co-axial first inner and first outer pipes each with a coupling end, the inner pipe having, secured to its coupling end, a first spigot, the outer pipe extending beyond the coupling end of the inner pipe and having, secured to its coupling end, a hollow cylindrical bolt;

the second member having co-axial second inner, second outer and intermediate pipes each with a coupling end, the outer and intermediate members being connected together at the coupling end of the outer member, by a connecting piece which has a flanged cylindrical extension on which is rotatably located a flanged nut, the inner and intermediate members extending beyond the coupling end of the outer member and being secured together at the coupling end of the intermediate member by a flanged second spigot, the flange being secured to the coupling end of the intermediate pipe and the spigot extending along the inner pipe to adjacent its coupling end;

there being a cryogenic seal attached to one of the spigots, the seal having an extension extending beyond the inner pipe associated with that spigot and being adapted to fit over the other spigot when the two first and second members are brought together, the extension having at least one annular groove in its inner circumference.

Each of the first and second members will preferably contain a valve, which will preferably be insulated or insulatable, for example by vacuum. Alternatively, of course, valves can be fitted to the supply and delivery systems adjacent to the attachment points of the first and second members.

Some embodiments of the invention will now be described, by way of example only, with reference to the accompanying diagrammatic drawings, of which:

Figure 1 is an elevation of a cryogenic liquid delivery system with a first member according to the invention attached thereto,

Figure 2 is an elevation of a second member according to the invention adjacent to a delivery pipe from a cryogenic liquid supply system,

Figure 3 is an elevation, in section, of a coupling end of a first member according to the invention,

Figure 4 is an elevation, in section, of a coupling end of a second member according to the invention,

Figure 5 is an elevation, in section, of the first member and second member connected together,

Figure 6 is an end view of a nut as used in the connection of the first and second members, and

Figure 7 is an end view of a spanner for use with the nut of Figure 6.

A cryogenic quick release coupling has two members, a first member 10 (Figure 1) shown attached to a cryogenic liquid delivery pipe 11, the attachment being by means standard in the cryogenic art and hence not described here, and a second member 12 (Figure 2) attachable to a cryogenic liquid supply pipe 13, again by means standard in the art. Each of the first and second members 10, 12 has

a standard cryogenic liquid valve 14, preferably of the vacuum insulated type, fitted thereto, and the first member 10 also has a relief valve 15.

The first member 10 (Figure 3) has an inner pipe 16 co-axial with an outer pipe 17, these being referred to herein as the first inner and first outer pipes respectively. Coupling ends 18, 19 of pipes 16, 17 are shown in Figure 3. Secured to the coupling end 18 of the first inner pipe 16 is a spigot 20 which has a cylindrical body 21 extending away from the end 18 to a flange 22, the flange carrying a retaining cylinder 23 which extends back towards the end 18. The outer pipe 17 extends beyond the coupling end 18 of the inner pipe 16 and has, secured to its coupling end 19, a hollow cylindrical bolt 24, the bolt 24 carrying, on its inner circumference, a guide cylinder 25.

The second member 12 (Figure 4) has an inner pipe 26 co-axial with an outer pipe 27, these being referred to herein as the second inner and second outer pipes respectively. Coupling ends 28, 29 of pipes 26, 27 are shown in Figure 4. Secured to the coupling end 29 of the outer pipe 27 is the external circumference of a first flange 30 of a bush 31 which carries on its inner circumference an intermediate pipe 32, co-axial with the pipes 26, 27, which extends to adjacent, but short of, the coupling end 28 of the inner pipe 26. A second flange 33 of the bush 31 retains a flange 34 of a rotatable nut 35. At its coupling end 28 the inner pipe 26 is secured to the intermediate pipe 32 by a spigot 36 which has a flange 37, secured to the intermediate pipe 32, and an externally threaded cylindrical portion 38 on which is screwed a cryogenic seal 39, the seal being formed of a low temperature insensitive material such as nylon. The seal extends beyond the coupling end 28 of the inner pipe 26 and has inner and outer diameters which enable it to fit between the body 21 of the spigot 20, and the retaining cylinder 23, at the coupling end 18 of the first inner pipe 16 of the first member 10. On the inner circumference of the seal 39 are a number, for example three, of annular grooves 40.

Each of the two members 10, 12 will also normally include means (not shown) for evacuating spaces external to the first and second inner pipes 16, 26. It is envisaged that couplings according to the invention will usually be used in conjunction with conventional vacuum insulated cryogenic liquid transfer systems. Means for applying vacuum to such systems are standard to the art and are therefore not described herein.

In use, the first member 10 is attached as shown in Figure 1 to a cryogenic liquid delivery pipe 11 and the second member 12 is attached to a cryogenic liquid supply pipe 13 as shown in Figure 2. The first 10 and second 12 members are then coupled together by introducing the intermediate pipe 32 of the second member 12 through the guide cylinder 25 of the first member 10. The members 10, 12 are moved together until the cryogenic seal 39 penetrates the space between the spigot 20 and the retaining cylinder 23 of the first member 10 and the nut 35 contacts the bolt 24. The nut 35 is then screwed onto the bolt 24, forcing the members 10, 12 close together and moving the seal 39 further between the spigot 20 and cylinder 23.

Once the connection has been made the various components of the completed delivery system are evacuated, the valves 14 (if closed) are opened and cryogenic liquid transfer through the inner pipes 16, 26 is commenced in the normal manner.

At the start of the transfer process some of the liquid will seep into the grooves 40 in the seal 39 preventing further seepage of liquid past the seal into the space external to the first and second inner pipes 16, 26.

On completion of transfer the valves 14 are turned off and the coupling released by unscrewing the nut 35 from the bolt 24. As the nut and bolt connection is separated from the cryogenic liquid passage pipes 16, 26 by a vacuum its temperature will have remained substantially at ambient and separation in the conventional manner will be a simple matter. Separation is aided by the liquid nitrogen which flashes off as the vacuum is removed to generate a gas pressure which urges the two outer pipes 17,27 apart.

In a test installation using the invention with transfer of liquid nitrogen, with a grooved nut 35 and C spanner, disconnection has been achieved in times of 37, 42 and 30 seconds respectively. These times were adversely affected by slipping of the C spanner, and an improved form of nut with an associated spanner are shown in figures 6 and 7. The nut 35 has three grooves 42 and the spanner 43 has three pegs 44, for association with the grooves 42, and an operating handle 45. It will be realised that with this latter arrangement the spanner 43 must be left in position whilst the connection remains made. Many other suitable forms of nut and spanner will, of course, be apparent.

It will, of course, be apparent that many other constructions of members 10, 12 are possible within the scope of the invention. For example, these members may be made integral with supply pipes 13 and delivery pipes 11. Alternatively when the members 10, 12 are separate items valves 14 may be positioned in the supply and delivery pipes 13, 11 respectively rather than in the members themselves.

CLAIMS

1. A quick release cryogenic coupling comprising first and second members each having inner and outer pipes, the inner pipe extending beyond the outer pipe in one member and the outer pipe extending beyond the inner pipe in the other member; an intermediate pipe provided on at least one member; connection means for releasably securing the outer pipe of the first member with the outer pipe of the second member in gas tight connection; and a cryogenic seal carried on one inner pipe; the configuration being such that, when the two members are connected together with the inner pipes connected by the cryogenic seal an evacuated space can be provided between the intermediate and inner pipes.

2. A coupling as claimed in Claim 1 wherein the intermediate pipe is in the member where the inner pipe extends beyond the outer pipe.

3. A coupling as claimed in Claim 2 wherein the construction is such that the space between the intermediate and inner pipes contains a permanent vacuum.

4. A coupling as claimed in Claim 2 wherein the construction is such that the space between the intermediate and inner pipes can be evacuated during operation of the connection.

5. A coupling as claimed in any one of Claims 1 to 4 wherein the construction is such that, when the members are connected an evacuated space can be provided between the cryogenic seal and the outer pipe.

6. A coupling as claimed in any one of Claims 1 to 5 wherein the cryogenic seal is attached to a first spigot secured to one inner pipe and in use slides onto a second spigot attached to the other inner

pipe.

7. A coupling as claimed in any one of Claims 1 to 6 wherein the cryogenic seal has an inner circumference having at least one annular groove therein.

8. A coupling as claimed in Claim 1 wherein the first member and second member is each attachable to either a delivery system or to a supply system;

the first member having co-axial first inner and first outer pipes each with a coupling end, the inner pipe having, secured to its coupling end, a first spigot, the outer pipe extending beyond the coupling end of the inner pipe and having, secured to its coupling end, a hollow cylindrical bolt;

the second member having co-axial second inner, second outer and intermediate pipes each with a coupling end, the outer and intermediate members being connected together at the coupling end of the outer member, by a connecting piece which has a flanged cylindrical extension on which is rotatably located a flanged nut, the inner and intermediate members extending beyond the coupling end of the outer member and being secured together at the coupling end of the intermediate member by a flanged second spigot, the flange being secured to the coupling end of the intermediate pipe and the spigot extending along the inner pipe to adjacent its coupling end;

there being a cryogenic seal attached to one of the spigots, the seal having an extension extending beyond the inner pipe associated with that spigot and being adapted to fit over the other spigot when the two first and second members are brought together, the extension having at least one annular groove in its inner circumference.

9. A coupling as claimed in any one of Claims 1 to 8 wherein at least one of the first and second members contains a valve.

10. A coupling as claimed in Claim 9 wherein the valve is vacuum

insulated.

11. A quick release cryogenic coupling substantially as herein described with reference to Figures 1 to 7 of the accompanying drawings.

12. A quick release cryogenic coupling substantially as herein described.

Fig.1.

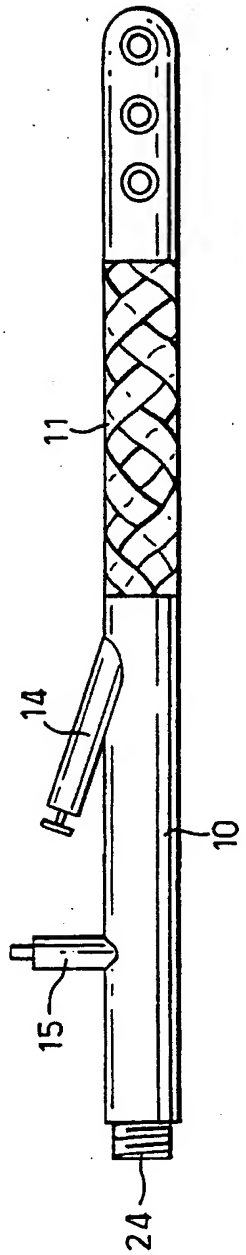

Fig.2.

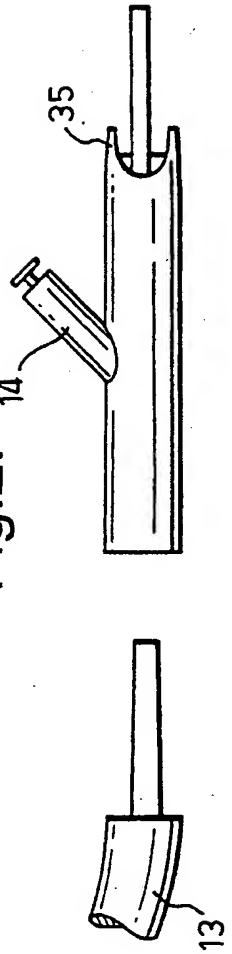

Fig.3.

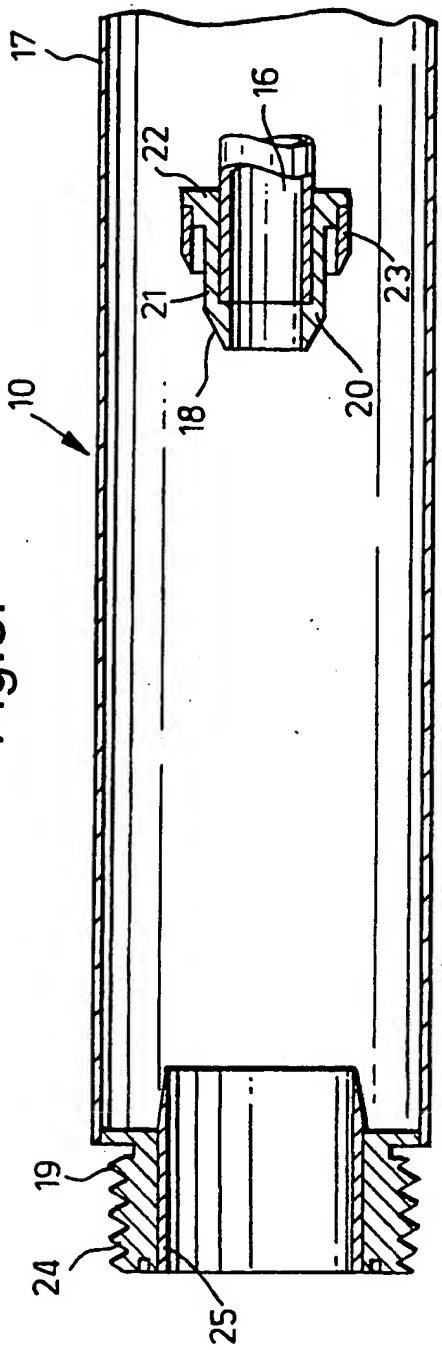
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Fig.4.

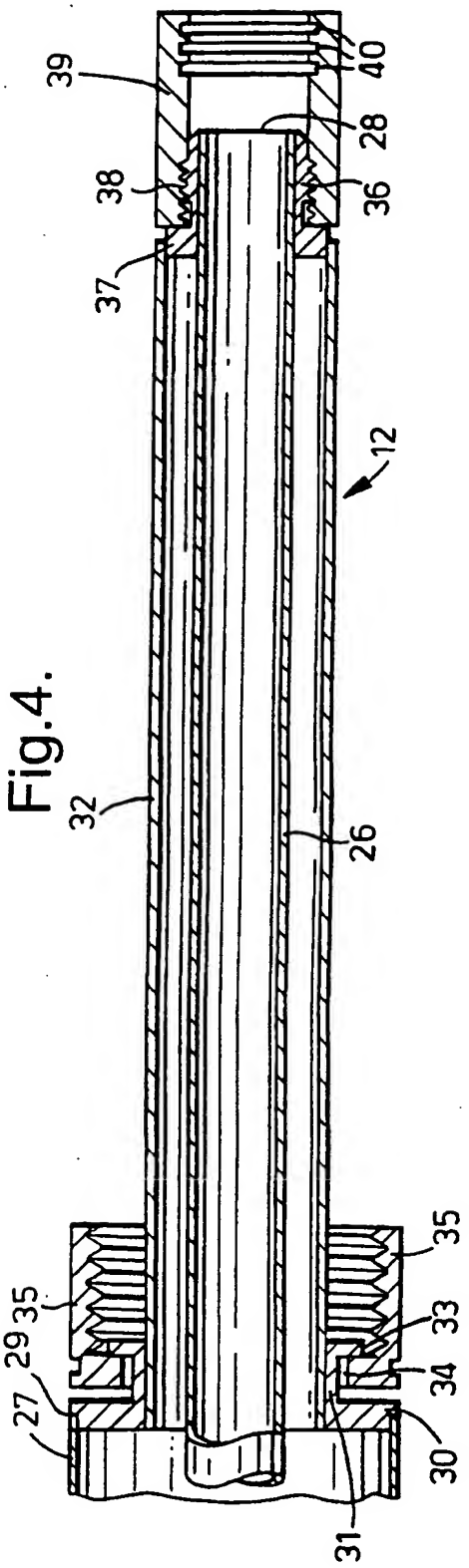
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Fig.5.

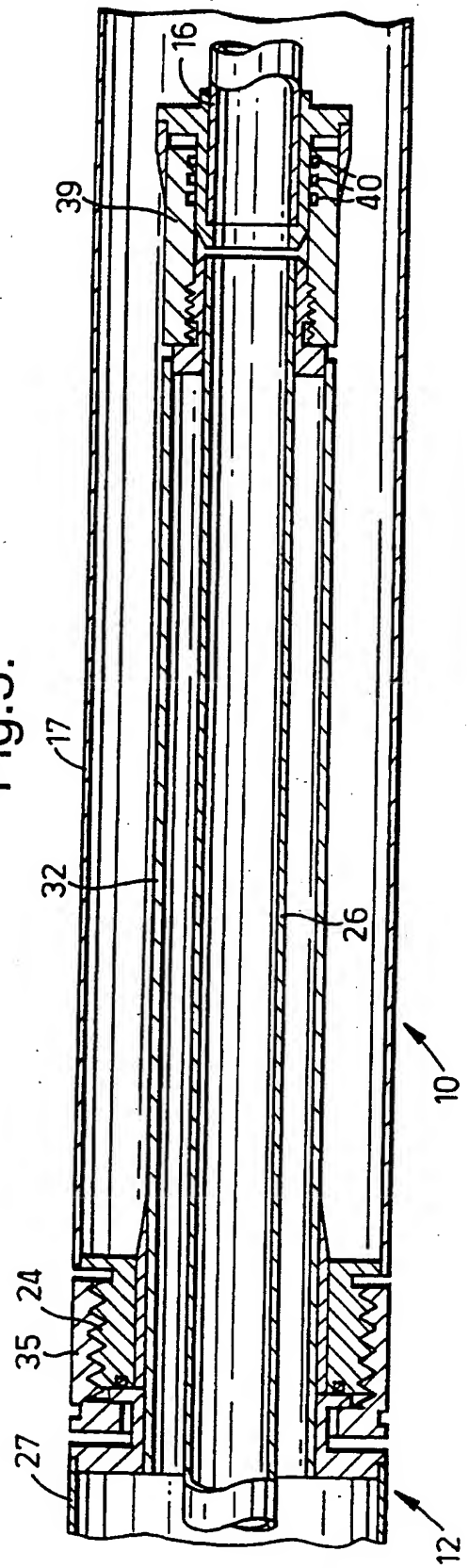


Fig.7.

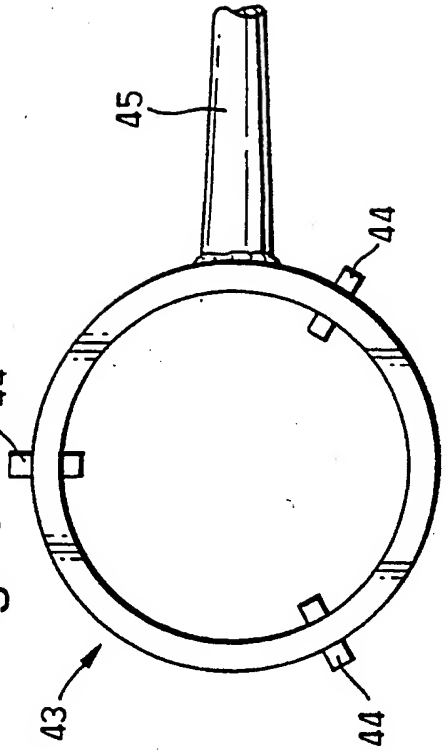
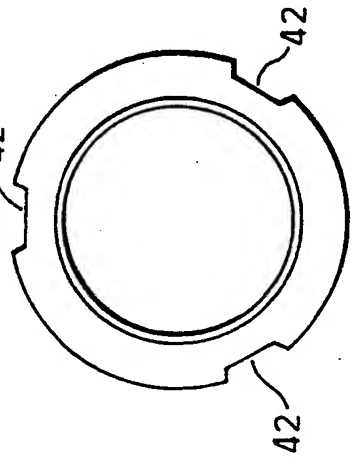


Fig.6.



INTERNATIONAL SEARCH REPORT

Inter nal Application No
PCI/GB 96/02042

A. CLASSIFICATION OF SUBJECT MATTER
IPC 6 F16L39/00 F16L59/06

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B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 6 F16L

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

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C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	DE,A,41 07 652 (BAYERISCHE MOTOREN WERKE AG) 10 September 1992 see abstract; figures 2,4 ---	1-8,11, 12
X	US,A,3 137 143 (JACOBS ET AL) 16 June 1964 see column 3, line 41 - line 45; figures ---	1-6,9-12
X	US,A,4 491 347 (GUSTAFSON KEITH W) 1 January 1985 see abstract; figures ---	1-6,11, 12
X	US,A,5 253 675 (OOSHIO TAKEAKI ET AL) 19 October 1993 see figures ---	1-5,9, 11,12
X	US,A,4 011 732 (DOHERTY PAUL R ET AL) 15 March 1977 see abstract; figures ---	1
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[X] Patent family members are listed in annex.

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X	US,A,3 988 029 (GIBSON CLARENCE JOHN) 26 October 1976 see abstract; figures -----	1

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Information on patent family members

Inter vnal Application No
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Patent document cited in search report	Publication date	Patent family member(s)	Publication date
DE-A-4107652	10-09-92	NONE	
US-A-3137143	16-06-64	NONE	
US-A-4491347	01-01-85	NONE	
US-A-5253675	19-10-93	KR-Y- 9502530	08-04-95
US-A-4011732	15-03-77	NONE	
US-A-3988029	26-10-76	NONE	